CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

35153

Project Title

Discovery of MSG as an Inducing Factor of Increased Lipid Storage Through Expression of AMPK-activated Protein Kinase

Abstract

Objectives/Goals

Obesity is a serious medical condition that occurs when too much fat has accumulated in one#s body. It occurs due to genetic makeup, diet, or lack of exercise. Adenosine monosphate activated protein kinase, or AMPK, is a key enzyme involved in regulating metabolism that has been shown to induce obesity by increasing the hunger stimulus and decreasing energy expenditure. The objective of my project was two-fold: firstly, to determine monosodium glutamate (MSG), as a causative factor of obesity in C. Elegans through elevated expression of AMPK; secondly, to identify MSG as a causative factor of Alzheimers by observing its effects on neurological function.

Methods/Materials

In my experiment, two different strains of C. Elegans were used: an N2 wildtype strain, and an AMPK mutant strain. A Nile Red Stain was conducted twice with four different samples and four subjects for each sample to observe lipid storage. A Western blot was conducted twice to measure AMPK expression in both lines. Locomotion and chemotaxis assays were used to measure behavioral function after worms were fed with 0, 50, 100, and 250 microliters of MSG. Each of the four different experiments was repeated twice.

Results

My results showed that as MSG treatment increased, the lipid storage in the worms also increased. Since the Nile Red Stain causes the the lipid deposits to fluoresce, I conducted qualitative comparisons. Lipid storage was much greater in the mutant AMPK line than the normal line, indicating that AMPK did lead to increased obesity in the worms. This was also shown in the Western blot, where AMPK expression directly correlated to increased MSG dosage. A 60% decrease in locomotion was recorded as MSG dosage increased by 250%; additionally, 82% of the worms displayed a negative response to MSG in the chemotaxis.

Conclusions/Discussion

Based on this analysis, MSG did induce increased lipid storage in C. Elegans through AMPK expression, showing that monosodium glutamate directly activates hypothalamic AMPK, which in turn induces obesity; AMPK targeted treatments could be analyzed as a novel field of study for combating obesity, potentially helping millions around the world. The excitotoxicity effects of MSG lead to decreased neurological function and may play a role in the development of neurodegenerative diseases.

Summary Statement

I discovered MSG as a causative factor of obesity and identified the novel correlation between expression of AMPK and increased lipid storage.

Help Received

Worked under guidance of Dr. Chambers. Mrs. Nguyen and parents provided support.